SCOPE OF WORK
PURCHASE OF TWO (2) COORDINATE MEASUREMENT MACHINE SYSTEMS

1. Description of Requirement: We have a requirement to purchase two (2) Coordinate Measuring Machines (CMM) that includes metrology software in order to support mission goals. Both systems shall be able to support precision measurement of complex geometries on medium to large scale components and be capable of being coupled with software capable of capturing and compiling data points for comparison to design models as well as open setup dimensional inspection. Both systems shall include training on both the hardware function and software application.

2. System Requirements Overview: Each CMM shall include:

   Each CMM shall be capable of operating accurately in a controlled environment between 18C to 22C. Additionally each CMM shall be capable of automatic operation using PCDMIS CAD++, and be able to maintain accuracies when checking items covered in the travel paths outlined in 4.0 for each configuration required. They shall be capable of utilizing point probe, scanning probe, laser scanning probe and optical/video probe attachments as either stand alone or in coordinated, collaborative methods to measure components with simple to complex geometries. Air dryer, holding fixtures, probe kits, training, computers and other peripherals shall be included as outlined in 4.0 below. Thermal compensation shall be integral to the system control. Operational in a windows based environment utilizing Windows 7.

3. Specification requirements for the software: (one new license and one transfer)

   3.1.1. Core software module must meet or exceed the following identified capabilities:

   3.1.2. Seat of PCDMIS CAD++ with Autopath, Toolchanger software bundle.

   3.1.3. Ability to export standard 3D CAD formats including AS3, DES, DXF, DWG, Generic, IGES, POINTCLOUD, STEP, VDAFS, XAML, SYZ, BASIC, DMIS, EXCEL and STL.

   3.1.4. Ability to import standard 3D CAD formats including DES, DXF, IGES, STEP, VDAFS, DATALOG, DMIS, and CSV.

   3.1.5. Ability to restart from any point on the path or nest sequence.

   3.1.6. Provide an interface to control feature probing, probe scanning, laser scanning and optical data capture collaboratively on the same job.

   3.1.7. Display of inspection data to include numerical and graphical depictions.

   3.1.8. Ability for geometry construction, geometry evaluation and analysis capabilities.

3.1.9. Multiple reporting options with fully dynamic reporting using tables, charts angraphics.

3.1.10. Spatial transformations and relationships capability shall be native included.

3.1.11. Calibration routines shall be included as a part of the software package.

4. Specification requirements for the Hardware (each CMM unless otherwise noted)

4.1.1. **CMM #1** shall include, meet or exceed the following requirements.

4.1.2. One piece granite table construction Max part weight 2860 lbs.

4.1.3. Minimum X travel 35.43 inches (900 mm) across gantry.

4.1.4. Minimum Y travel 47.24 inches (1200 mm) along table.

4.1.5. Minimum Z travel 31.5 inches (800 mm).

4.1.6. Full system volumetric accuracy requirements based on ISO 10360 standards shall meet or exceed 1.5 +3.0L/1000 including the articulating probe head.

4.1.7. Probing error shall not exceed 1.4 microns

4.1.8. Scanning probe errors shall not exceed 2.5 microns or 45 seconds.

4.1.9. Unit shall be capable of maintaining stated accuracies in temperatures ranging from 18C to 22C.

4.1.10. Test configuration for articulating probe shall be a 5 mm tip diameter with either 50 mm or 120 mm stylus length;

4.1.11. Motorized probe head capabilities shall be angular rotation in the A axis of +90 to – 115 degrees, B axis of =/- 180 degrees. With a 5 degree angular rotation step in both axis for 3,024 positions.

4.1.12. Minimum angular position accuracy of .5 microns for the Motorized probe head.

4.1.13. Motorized probe shall be capable of mounting both laser scanning and optical video probe heads as an infield upgrade.

4.1.14. The system shall be capable of operating from a 64 bit windows based desktop workstation computer that will be included in the procurement. Windows 7 operating systems compatible. Quad Core XEON E5-1607, 3.0GHz, 10MB
RAM: 6 GB DDR3,1600MHz,NECC,4x2GB
HD: 600GB,SAS,2.5",10,000rpm
DVD: 16X DVD+/-RW

GRAPHICS: 2GB nVIDIA Quadro K2000, 2DP and 1DVI
MOUSE: Dell MS111 USB Optical Mouse
OS: Windows 7 Professional, 64-bit
LAN: 2 Gigabit Ethernet Ports
PORTS: 1 Serial Port

4.1.15. QTY (2) Dell 24" Flat Panel Dell UltraSharp U2412M LCD Monitor,

4.1.16. HP Officejet 4630 e-ALL-IN-ONE Printer

4.1.17. Ergonomic computer workstation table 47.2X26.8X33.5

4.1.18. CMM control shall be capable of 3D speeds up to 866 mm per second and 3D acceleration up to 4300 mm per second squared while maintain accuracies stated.

4.1.19. An auxiliary remote control shall be included with cable connectivity and hot key capacity.

4.1.20. Single CMM air dryer capable of flow rates up to 20 CFM

4.1.21. Probe Qualification Sphere 25 mm diameter ceramic with a 30 degree angle support shaft 264 mm long.

4.1.22. 32 element Fixture starter kit consisting of:

(Qty. 2) Tension Clamp Medium
(Qty. 2) Tension Clamp Posts
(Qty. 1) Slider Block
(Qty. 3) Stand Off Flat Magnet
(Qty. 4) Cones Nylon
(Qty. 1) Starter Case
(Qty. 1) User Guide
(Qty. 1) Thumbscrew M8
(Qty. 2) Ø16 x 20 Stand Off
(Qty. 2) Ø16 x 30 Stand Off
(Qty. 2) Ø16 x 50 Stand Off
(Qty. 2) Ø20 x 20 Stand Off
(Qty. 2) Ø20 x 30 Stand Off
(Qty. 2) Ø20 x 50 Stand Off
(Qty. 2) Stand Off Pin
(Qty. 2) Baseplate Retainers
(Qty. 1) Baseplate 300 mm x 400 mm x 12 mm thick with Alpha/ Numeric legend identification and holding plates

4.1.23. Probe accessory kit

(Qty. 1) Scanning probe
(Qty. 2) Stylus Holder, M3, Aluminum
(Qty. 1) Stylus Holder, rotatable, Aluminum/Steel
(Qty. 2) Stylus Ø 3.0 mm x L 20 mm, Steel

(Qty. 1) Stylus Ø 5.0 mm x L 20mm, Steel
(Qty. 1) Stylus Ø 5.0 mm x L 50 mm, Steel
(Qty. 1) Stylus Ø 8.0 mm x L 75 mm, Carbon Fiber
(Qty. 1) Extension, L 50 mm, Carbon Fiber
(Qty. 1) Extension, L 150 mm, Carbon Fiber
(Qty. 1) Cube, 13 mm, Aluminum
(Qty. 1) Mounting Key
(Qty. 2) Mounting Pins
(Qty. 1) Auto stylus change rack

4.2.1. **CMM #2** shall include, meet or exceed the following requirements.

4.2.2. One piece granite table construction Max part weight 3960 lbs.

4.2.3. Minimum X travel 47.24 inches (1200 mm) across gantry.

4.2.4. Minimum Y travel 59.06 inches (1500 mm) along table.

4.2.5. Minimum Z travel 39.37 inches (1000 mm).

4.2.6. Full system volumetric accuracy requirements based on ISO 10360 standards shall meet or exceed 2.1+3.0L/1000 including the articulating probe head.

4.2.7. Probing error shall not exceed 1.8 microns

4.2.8. Scanning probe errors shall not exceed 3.1 microns or 45 seconds.

4.2.9. Unit shall be capable of maintaining stated accuracies in temperatures ranging from 18 degrees Celsius to 22 degrees Celsius.

4.2.10. Test configuration for articulating probe shall be a 5 mm tip diameter with either 50 mm or 120 mm stylus length;

4.2.11. Motorized probe head capabilities shall be angular rotation in the A axis of +90 to – 115 degrees, B axis of =/- 180 degrees. With a 5 degree angular rotation step in both axis for 3,024 positions.

4.2.12. Minimum angular position accuracy of .5 microns for the Motorized probe head.

4.2.13. Motorized probe shall be capable of mounting both laser scanning and optical video probe heads as an infield upgrade.

4.2.14. The system shall be capable of operating from a 64 bit windows based desktop workstation computer that will be included in the procurement. Windows 7 operating systems compatible. Quad Core XEON E5-1607, 3.0GHz, 10MB
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HD: 600GB, SAS, 2.5", 10,000rpm
DVD: 16X DVD+/-RW

GRAPHICS: 2GB nVIDIA Quadro K2000, 2DP and 1DVI
MOUSE: Dell MS111 USB Optical Mouse
OS: Windows 7 Professional, 64-bit
LAN: 2 Gigabit Ethernet Ports
PORTS: 1 Serial Port

4.2.15. QTY (2) Dell 24" Flat Panel Dell UltraSharp U2412M LCD Monitor,

4.2.16. HP Officejet 4630 e-ALL-IN-ONE Printer

4.2.17. Ergonomic computer workstation table 47.2X26.8X33.5

4.2.18. CMM control shall be capable of 3D speeds up to 866 mm per second and 3D acceleration up to 4300 mm per second squared while maintain accuracies stated.

4.2.19. An auxiliary remote control shall be included with cable connectivity and hot key capacity.

4.2.20. Single CMM air dryer capable of flow rates up to 20 CFM

4.2.21. Probe Qualification Sphere 25 mm diameter ceramic with a 30 degree angle support shaft 264 mm long.

4.2.22. 32 element Fixture starter kit consisting of:

(Qty. 2) Tension Clamp Medium
(Qty. 2) Tension Clamp Posts
(Qty. 1) Slider Block
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(Qty. 4) Cones Nylon
(Qty. 1) Starter Case
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(Qty. 2) Ø20 x 30 Stand Off
(Qty. 2) Ø20 x 50 Stand Off
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(Qty. 1) Stylus Ø 8.0 mm x L 75 mm, Carbon Fiber
(Qty. 1) Extension, L 50 mm, Carbon Fiber
(Qty. 1) Extension, L 150 mm, Carbon Fiber
(Qty. 1) Cube, 13 mm, Aluminum
(Qty. 1) Mounting Key
(Qty. 2) Mounting Pins
(Qty. 1) Auto stylus change rack

5. Acceptance and title transfer requirements for the system:

5.1.1. Delivery of passing calibration report for each installed CMM.

5.1.2. Title transfer occurs upon delivery of 5.1.1 to AMB QC department.

6. Additional requirements

6.1.1. One (1) year system warranty on each CMM system.

6.1.2. Transfer of existing customer owned PCDMIS CAD++ Autopath license to the CMM #2 including setup and machine specific interfaces.

7. Training Requirements:

7.1.1. Onsite system hardware and calibration software training for minimum of four technicians.

7.1.2. Offsite PCDMIS CAD++ training for a total of 40 days to be used as customer needs. Training credits to be used within 2 years of date of shipment.

7.1.3. Telephone software support shall be provided for one (1) year for each CMM.

8. Delivery, Shipping and Rigging Requirements:

8.1.1. Shipping and Delivery to Goddard to be included in proposal.

8.1.2. Rigging to NASA defined placement site to be included in proposal.

8.1.3. Delivery of both CMM systems from date of award shall not exceed 180 days. Staggered deliveries are acceptable providing the final delivery does not exceed the 180 day requirement.